INEEL/EXT-99-00020
Revision 2

Test Area North Operable Unit 1-07B Final Groundwater Remedial Action Health and Safety Plan

November 2002

Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho, LLC

INEEL/EXT-99-00020
Revision 2

Test Area North Operable Unit 1-07B Final Groundwater Remedial Action Health and Safety Plan

November 2002

Idaho National Engineering and Environmental Laboratory
Environmental Restoration Program
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE Idaho Operations Office
Contract DE-AC07-99ID13727

Test Area North Operable Unit 1-07B Final Groundwater Remedial Action Health and Safety Plan

INEEL/EXT-99-00020
Revision 2

November 2002

Approved by

Lee O. Nelson
Bechtel BWXT Idaho, LLC
OU 1-07B Project Manager

11/4/02
Date

Kerry D. Briar
Bechtel BWXT Idaho, LLC
OU 1-07B Safety, Health, and Quality Point of Contact

11-5-02
Date

ABSTRACT

This Health and Safety Plan (HASP) establishes the procedures and requirements that will be used to eliminate or minimize health and safety risks to personnel working at the Operable Unit 1-07B site, as required by the Occupational Safety and Health Administration standard, "Hazardous Waste Operations and Emergency Response" (29 CFR 1910.120 or 1926.65). This HASP contains information about the hazards involved in performing the work as well as the specific actions and equipment that will be used to protect personnel while working at the task site.

This HASP is intended to give safety and health professionals the flexibility to establish and modify site safety and health procedures throughout the entire span of site operations based on the existing and anticipated hazards.

CONTENTS

FIGURES

TABLES

ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASTU	air stripper treatment unit
CERCLA	Comprehensive Environmental, Response, Compensation, and Liability Act
CFA	Central Facilities Area
CFR	Code of Federal Regulations
CNS	central nervous system
COC	contaminant of concern
CRC	contamination reduction corridor
CRZ	contamination reduction zone
DAC	derived air concentration
DAR	Document Action Request
dBA	decibel A-weighted
DCE	dichloroethene
DOE	U.S. Department of Energy
DOE-ID	U.S. Department of Energy Idaho Operations Office
EPA	U.S. Environmental Protection Agency
ER	environmental restoration
ERO	Emergency Response Organization
ES&H	environment, safety, and health
ESH&QA	environmental, safety, health, and quality assurance
EZ	exclusion zone
FCC	field construction coordinator
FSP	Field Sampling Plan

FTL	field team leader
FY	fiscal year
GDE	guide
GWTF	Groundwater Treatment Facility
HASP	Health and Safety Plan
HAZMAT	hazardous material
HAZWOPER	hazardous waste operations and emergency response
HEPA	high-efficiency particulate air
HSO	health and safety officer
IARC	International Agency for Research on Cancer
IEDMS	Integrated Environmental Data Management System
IH	industrial hygienist
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISB	in situ bioremediation
ISMS	Integrated Safety Management System
JSA	job safety analysis
JSS	job site supervisor
LTS	long-term stewardship
MCL	maximum contaminant level
MCP	management control procedure
MNA	monitored natural attenuation
NFPA	National Fire Protection Association
NIOSH	National Institute of Occupational Safety and Health
NPTF	New Pump and Treat Facility
NRR	noise reduction rating

NTP	National Toxicology Program
OMP	Occupational Medical Program
OSHA	Occupational Safety and Health Administration
OU	operable unit
PCE	tetrachloroethene
PE	project engineer
PEL	permissible exposure limit
PEP	project execution plan
PLN	plan
PM	project manager
PMP	program management plan
POC	point of contact
POD	plan of the day
PPE	personal protective equipment
PRD	program requirements document
QA	quality assurance
QAPjP	Quality Assurance Project Plan
RadCon	Radiological Control
RAO	remedial action objective
RBA	radiological buffer area
RCIMS	Radiological Control and Information Management System
RCRA	Resource Conservation and Recovery Act
RCM	Radiological Control Manual
RCT	radiological control technician
RE	radiological engineer
RWP	radiological work permit

SAD	site area director
SCBA	self-contained breathing apparatus
SH&QA	safety, health, and quality assurance
SS	shift supervisor
STD	standard
STEL	short-term exposure limit
SWP	safe work permit
SZ	support zone
TAN	Test Area North
TCE	trichloroethene
TLV	threshold-limit value
TPR	technical procedure
TRAIN	Training Records and Information Network
TSF	Technical Support Facility
TWA	time-weighted average
UV	ultraviolet
VOC	volatile organic compound
VPP	Voluntary Protection Program
WAG	waste area group
WCC	Warning Communications Center

Test Area North Operable Unit 1-07B Final Groundwater Remedial Action Health and Safety Plan

1. INTRODUCTION

1.1 Purpose

This Health and Safety Plan (HASP) establishes the procedures and requirements that will be used to eliminate or minimize health and safety hazards to personnel working at the Test Area North (TAN) Operable Unit (OU) 1-07B final groundwater remedial action at the Idaho National Engineering and Environmental Laboratory (INEEL). The location of the INEEL and TAN is shown in Figure 1-1. This HASP has been prepared to comply with the authorized safety basis detailed in the *Preliminary Hazard Assessment Test Area North Groundwater Treatment Facility Operable Unit 1-07B* (INEEL 2001a).

- This HASP governs all work performed for the OU 1-07B project. This work includes Groundwater Treatment Facility (GWTF) operations and maintenance, including management and inspection of the New Pump and Treatment Facility (NPTF); GWTF; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) waste storage areas; and all other CERCLA storage areas associated with the TAN facility remedial action.
- In situ bioremediation (ISB) (including construction of a new facility).
- Groundwater monitoring and associated laboratory analysis.
- Monitored natural attenuation (MNA) field tests.
- Well drilling activities.
- Maintenance and well abandonment.
- Facility modifications.
- Geophysical down hole probing of wells.

1.2 Scope and Objectives

This HASP has been written to meet the requirements of the Occupational Safety and Health Administration (OSHA) standard, "Hazardous Waste Operations and Emergency Response (HAZWOPER)" (29 *Code of Federal Regulations* [CFR] 1910.120 or 1926.65). This HASP governs all work at the TAN OU 1-07B final groundwater remedial action that is performed by INEEL management and operations contractor personnel, subcontractors, and any other personnel who enter the project area.

This HASP has been reviewed and revised as deemed appropriate by the health and safety officer (HSO) in conjunction with other project personnel and management to ensure its effectiveness and suitability.

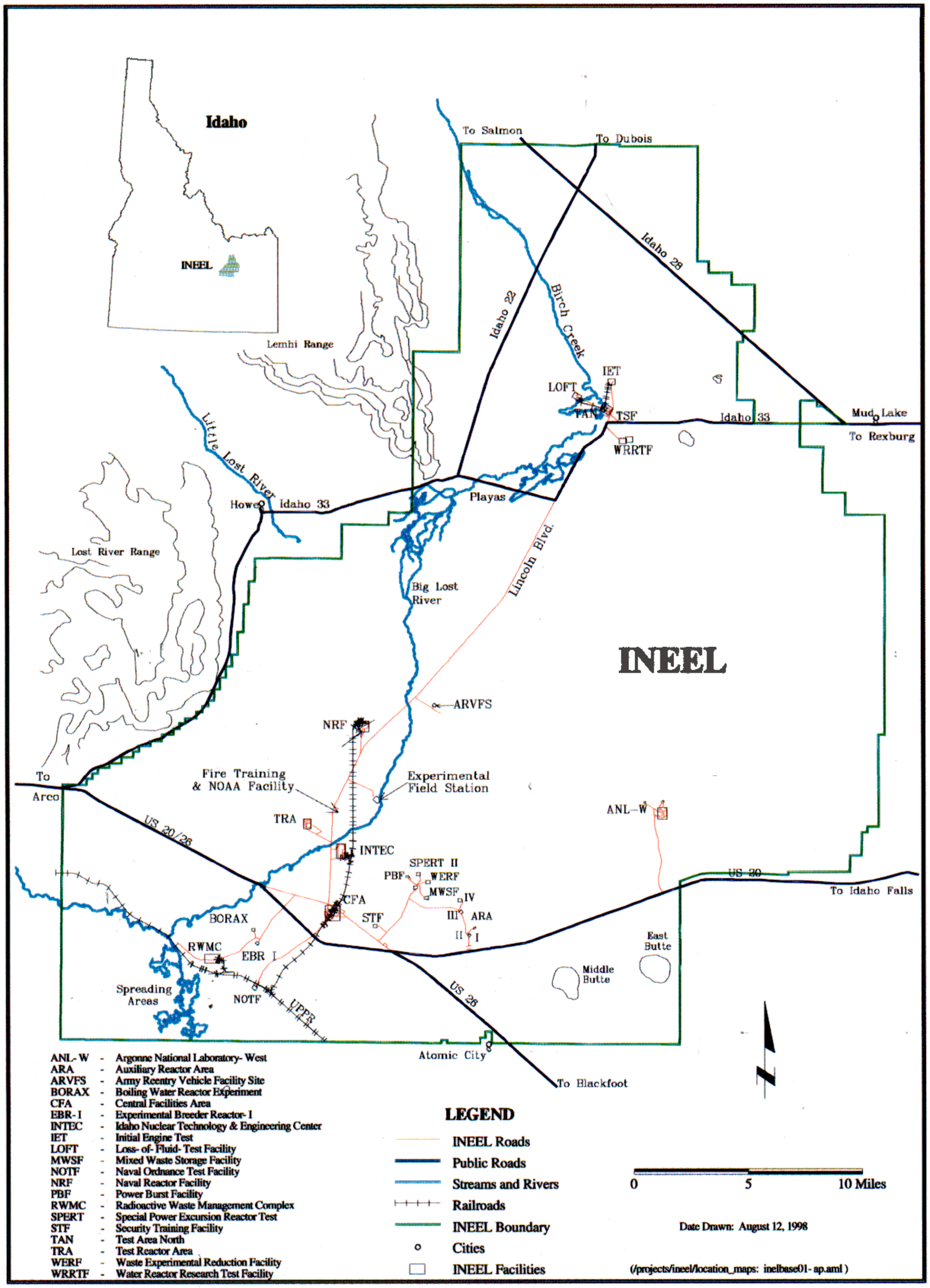

Figure 1-1. Map of the Idaho National Engineering and Environmental Laboratory Site showing the location of major facilities.

1.3 Idaho National Engineering and Environmental Laboratory Site Description

The INEEL—formerly the National Reactor Testing Station—encompasses 2,302 km^2 (889 mi^2) and is located approximately 55 km (34 mi) west of Idaho Falls, Idaho. The U.S. Department of Energy Idaho Operations Office (DOE-ID) has responsibility for the INEEL and designates authority to operate the INEEL to government management and operating contractors.

The United States Atomic Energy Commission, now the U.S. Department of Energy (DOE), established the National Reactor Testing Station (now the INEEL) in 1949 as a site for building and testing a variety of nuclear facilities. The INEEL has also been the storage facility for transuranic radionuclides and radioactive low-level waste since 1952. At present, the INEEL supports the engineering and operations efforts of DOE and other federal agencies in areas of nuclear safety research, reactor development, reactor operations and training, nuclear defense materials production, waste management technology development, energy technology and conservation programs, and DOE long-term stewardship (LTS) programs.

1.4 Background and Project Site Description

Test Area North is located in the northern portion of the INEEL. It consists of four major facilities that were used to develop a nuclear-powered aircraft and to conduct tests that simulate accidents involving the loss of coolant from nuclear reactors. The key area for this final remedial action is the Technical Support Facility (TSF) area, which is centrally located at TAN (Figure 1-2). The focus of this CERCLA remediation activity is OU 1-07B TAN final groundwater remediation, which includes remediation of the TAN TSF-05 injection well and the surrounding groundwater contamination areas (TSF-23). Industrial activities at the TSF generated wastewater that was introduced into the groundwater via the TSF-05 injection well.

The TSF-05 injection well, shown in Figure 1-2, was completed in 1953 to a depth of 93 m (305 ft). The well has a 30-cm (12-in.) diameter casing and is screened from 55 to 74 m (180 to 244 ft) and from 82 to 93 m (269 to 305 ft) below ground surface. The injection well, used from 1955 to 1972 to dispose of TSF-generated industrial and sanitary wastewater, is in the Snake River Plain Aquifer. The well was also used in the late 1950s and early 1960s to dispose of concentrated evaporator sludge from the processing of low-level radioactive waste and process waste.

Sampling of the drinking water and other TAN area wells from 1987 to 1990 confirmed the presence of trichloroethene (TCE) in the aquifer and also identified tetrachloroethene (PCE) as a contaminant that exceeded the drinking water standards. Table 1-1 presents ranges of contaminant concentrations in the groundwater. The TSF-05 injection well was identified as the source of the contamination.

Additional sampling of TSF-05 in August 1992 indicated the presence of 1,2-dichloroethene (DCE) in addition to the other contaminants. The presence of the TCE and PCE was further confirmed by the sampling results of the TSF-05, TAN-25, and TAN-26 wells in June 1993.

Contamination has been found from the top of the water table at 61 m (200 ft) to at least 122 m (400 ft) below ground surface. The highest groundwater contamination levels are found near the TSF-05, TAN-25, and TAN-26 wells. These levels drop rapidly as the distance from these wells increases. Since the TSF-05 well was constructed in 1953 and operated as an injection well for 20 years, the TCE has traveled as far as 2.4 km (1.5 mi) south to southeast with the groundwater flow. The other contaminants of concern (COCs) have not been found at levels above drinking water standards and at distances more than 0.4 km (0.25 mi) from the well.

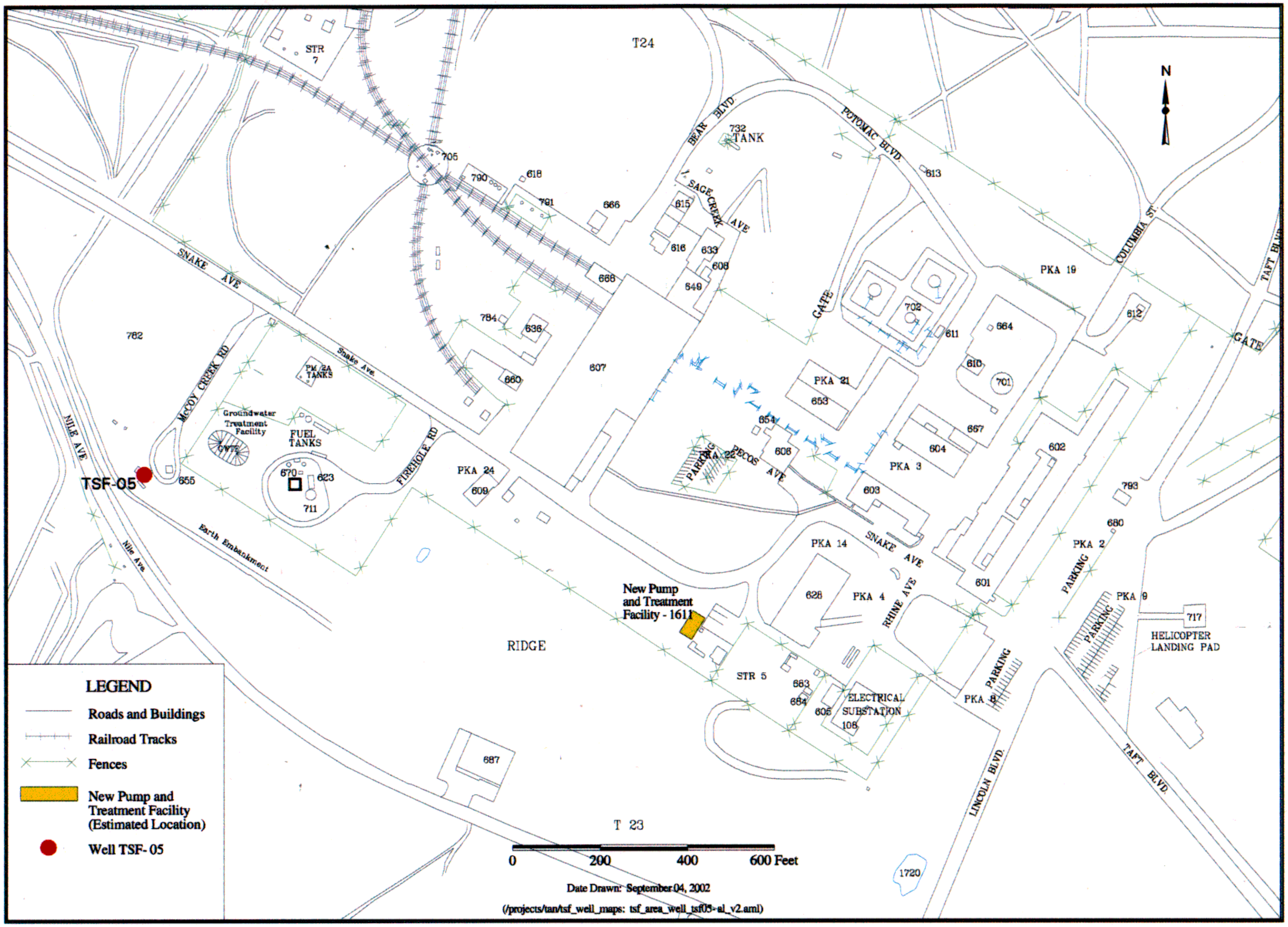

Figure 1-2. Location of the Technical Support Facility at Test Area North.

Table 1-1. Validated results showing the range of contaminant concentrations.[a, b]

Contaminant	TSF-05 Injection Well	TAN-25 Monitoring Well	TAN-26 Monitoring Well	MCL[c]
Organic Compounds (μg/L)				
PCE	14–440	4–<1,000[d]	14–26	5
TCE	4,400–164,000	3,400–17,000	480–2,200	5
Cis-1,2 DCE	2,800–15,000	890–3,500	165–1,700	70
Trans-1,2 DCE	1,300–13,000	450–2,000	16–63	100
Radionuclides[e] (pCi/L)				
Sr-90	530–2,310	370–440	0.8–4	8
Tritium (H-3)	11,400–29,600	7,500–14,200	3,500–4,800	20,000
U-234	1.0 E–02-17	7–10	1.7–3.4	30
U-235	6.43E-04–1.7E-01	—	—	30
U-238	7.08E-04–4.4E-01	0.64	1.4	30
Am-241/Pu-238	8.83E-02–2.19E-01	3 E-02 < 0.2	7 E-02 < 0.2	15[f]
Pu-239/Pu-240	6.88E-02–1.8E-01	6 E-02 < 0.2	0.1 < 0.2	15[f]
Cs-137	1,600–92,600	90–570	<30	119
Co-60	8.72–7,430	<20	<20	100[g]

a. Values are from the OU 1-07B remedial investigation, OU 1-07A final progress report for Batches 1 through 31, Phase 0 characterization, OU 1-07B surge and stress, and groundwater monitoring through October 1996.
b. Key: — indicates not sampled; <(number) indicates less than the detection limit.
c. MCL = maximum contaminant level per federal drinking water standards. The MCL for U-234 is for the U-234, -235, and -238 series and is from a proposed rate dated July 18, 1991. The MCL for Cs-137 is derived from a corresponding 4-mrem/yr effective dose equivalent to the public, assuming lifetime intake of 2 L/day of water.
d. Dilution factors of 1,000 and 200 were used during the March and June 1994 sample analyses, respectively. These dilution factors raised the detection limit for PCE to 1,000 mg/L for the March 1994 analysis and 200 mg/L for the June 1994 analysis.
e. Uncertainties are not provided in the table, but are reported with the original data. Radionuclides are associated with groundwater and sludge samples from the hot spot and are not associated with other OU 1-07B activities.
f. The MCL is for gross alpha particle activity (including radium-226, but excluding radon and uranium).
g. See *Primary Drinking Water Standards* (EPA 1985).

DCE = dichloroethene
EPA = U.S. Environmental Protection Agency
OU = operable unit
PCE = tetrachloroethene
TAN = Test Area North
TCE = trichloroethene
TSF = Technical Support Facility

1.5 Scope of Work

The objective of the OU 1-07B remedial action is to contain and remove the hot spot secondary source and to remediate the downgradient contaminated groundwater. Restoration of the groundwater will be complete when the concentration of contaminants found in the groundwater is reduced to below maximum contaminant levels, the carcinogenic risk is reduced to below 1 in 10,000 risk-based levels, and until the cumulative hazard index is less than 1 for non-carcinogens. Restoration of the contaminated groundwater is to be complete by 2095.

In the *Explanation of Significant Differences from the Record of Decision for the Technical Support Facility Injection Well (TSF-05) and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action* (INEEL 1997), the contaminant plume was divided into three zones to facilitate remediation of the plume. The boundaries of each zone of the plume were based on TCE concentrations. The three zones were defined as the hot spot where TCE concentrations exceed 20,000 μg/L, the medial zone where TCE concentrations range from 1,000 to 20,000 μg/L, and the distal zone where TCE concentrations range from 5 to 1,000 μg/L. The *Record of Decision Amendment—Technical Support Facility Injection Well TSF-05 and Surrounding Groundwater Contamination (TSF-23) and Miscellaneous No Action Sites, Final Remedial Action* (DOE-ID 2001) selected the following technologies to remediate each portion of the plume:

- ISB for the hot spot
- Pump and treat for the medial zone
- MNA of the distal zone.

Figure 1-3 identifies the OU 1-07B area of contamination and associated OU 1-07B planned facilities.

1.5.1 Hot Spot Remedial Action

Because of its demonstrated effectiveness, ISB has been selected to remediate the hot spot of the plume. In situ bioremediation is expected to operate through Fiscal Year (FY) 2018. To implement ISB, a treatment system is used to inject an electron donor—such as sodium lactate, whey, or molasses—through one or more wells into the hot spot. In situ bioremediation is the biochemical process carried out by bacteria that are naturally present in the groundwater at TAN that results when the electron donor is injected into the groundwater. It is anticipated that ISB is effective both for degrading the chloroethenes dissolved in groundwater and for accelerating degradation of the chloroethenes in the secondary source in the injection well.

The ISB field evaluation system is located in a portable trailer near the TSF-05 well and consists of a drum pump, process piping, and an electron donor storage area. This system will be replaced by a full-scale ISB injection facility that will be used to pump sodium lactate or other suitable electron donor (such as whey or molasses) from storage containers to the process piping, where it is mixed with potable water and injected into TSF-05 or other wells in the vicinity of the hot spot. A pipeline carries potable water into the ISB system and transports the electron donor to the injection well(s). New monitoring and injection wells will be drilled for this system. Electron donor is purchased from commercial vendors. The electron donor mixture enhances microbial degradation of groundwater contaminants. During the first several years of operation, the electron donor injection strategy will be optimized to ensure that the flux of contaminants from the hot spot is stopped.

Before ISB was selected to remediate the hot spot of the plume, two pump-and-treat facilities were constructed and operated to contain flux of contaminants from the hot spot: (1) the GWTF and (2) the air stripper treatment unit (ASTU). The GWTF is no longer being operated and is scheduled for decontamination and dismantlement during FY 2004. The ASTU is being maintained in a standby condition as a contingency until the remedial action in the hot spot is complete. In the event that radionuclide concentrations increase to unacceptable levels, the ASTU would be operated to remove groundwater from the aquifer, treat it to remove volatile organic compounds (VOCs), and reinject it at an upgradient location such as TAN-31 to facilitate sorption of radionuclides onto subsurface soil and rock within the hot spot. Figure 1-2 shows the GWTF, ASTU, and other OU 1-07B facilities and their locations relative to TSF operation facilities.

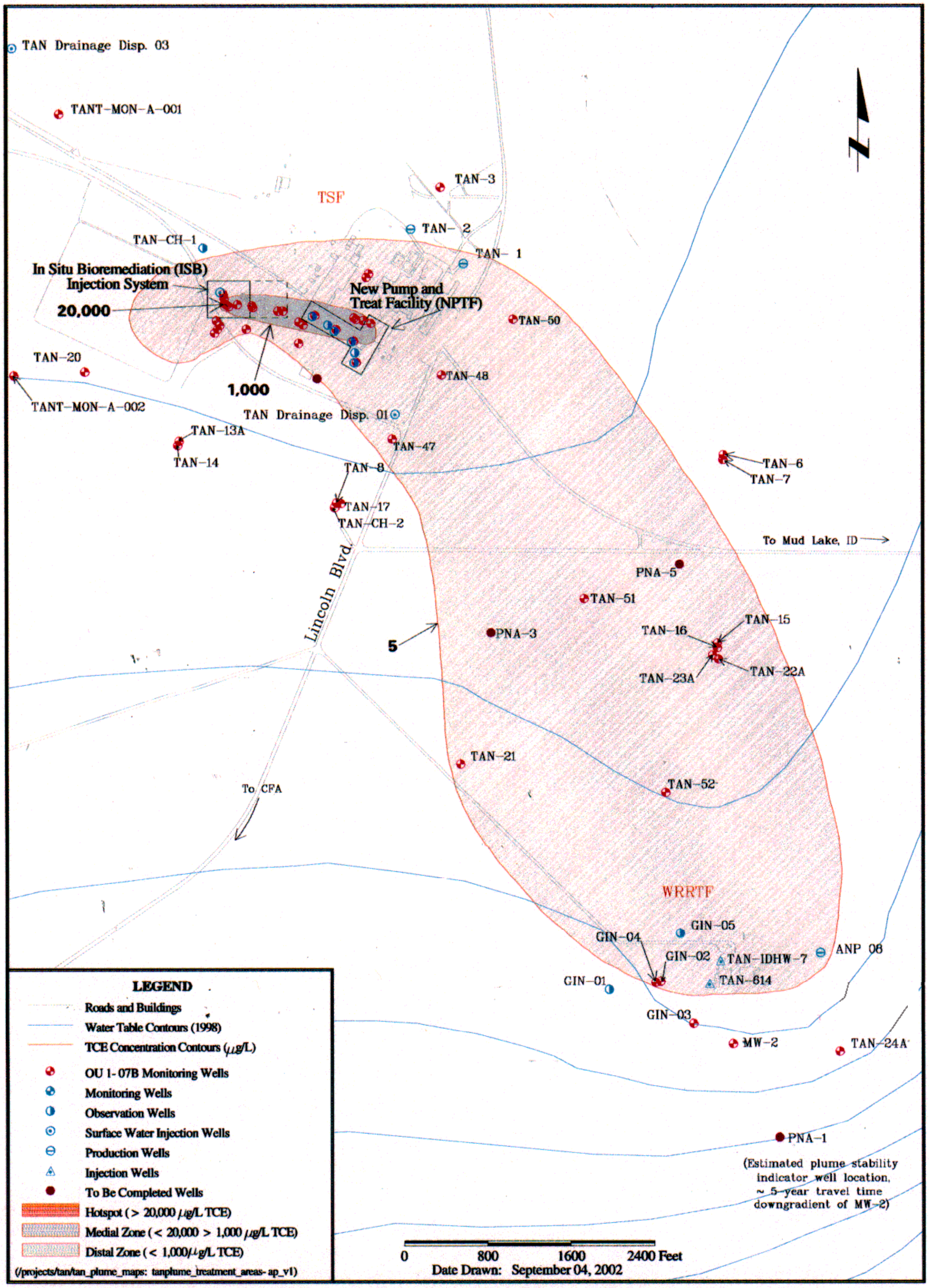

Figure 1-3. Concentrations of organic contaminants found in the contaminated groundwater and treatment facility locations.

Throughout the remedial action, groundwater will be monitored in accordance with the *Phase C Groundwater Monitoring Plan, Test Area North Operable Unit 1-07B* (INEEL 2002a). The plan will consider and support the remedial action objectives (RAOs) identified in the Record of Decision (DOE-ID 2001). Monitoring data will be used to optimize the electron donor injection strategy and to demonstrate the continued effectiveness of ISB.

1.5.2 Medial Zone Remedial Action

Medial zone remediation involves operation of the NPTF. The purpose of the NPTF is to capture and treat groundwater between the hot spot containment zone and the NPTF extraction wells. The extraction wells are located approximately 305 m (1,000 ft) downgradient from the TSF-05 injection well. The NPTF is used to extract groundwater from the medial zone, treat the extracted water in an air stripper to remove VOCs, and reinject treated water into the aquifer at a location downgradient of the NPTF.

The NPTF consists of the following equipment: (1) pumps to extract water from the TAN-38, TAN-39, and TAN-40 wells; (2) two parallel air stripper treatment trains that are designed to treat water at a flow rate of 473 L/min (125 gpm) each; (3) a building with concrete floor and sump, located near TAN-38; and (4) piping needed to discharge the effluent water into the injection well. The system pumps water from all or one of the wells at a nominal flow rate of 454 to 946 L/min (120 to 250 gpm). The extracted groundwater contains F001-listed hazardous waste and all components of the extraction system meet secondary containment requirements specified by the project's applicable or relevant and appropriate requirements. The contaminated groundwater is treated through the air strippers to remove VOCs to below maximum contaminant levels (MCLs) and to levels where the cumulative carcinogenic risk is less than 1×10^{-5}. After the air stripping process, the water (through approval of the Idaho Department of Environmental Quality) no longer contains the listed hazardous waste and is discharged to the TAN-53A injection well. The NPTF was designed to treat groundwater VOC concentrations at the time of the 1997 Explanation of Significant Differences (INEEL 1997), as shown in Table 1-2.

Table 1-2. New Pump and Treat Facility influent design concentrations.

Contaminant	Concentration (µg/L)	MCL (µg/L)
TCE	1,100	5
PCE	70	5
Cis-DCE	120	70
Trans-DCE	50	100

DCE = dichloroethene
MCL = maximum contaminant level
PCE = tetrachloroethene
TCE = trichloroethene

The NPTF water and air effluent are monitored in accordance with the *New Pump and Treat Facility Operations and Maintenance Plan for Test Area North Final Groundwater Remediation, Operable Unit 1-07B* (DOE-ID 2002a). Monitoring consists of collecting NPTF influent and effluent water samples, collecting air effluent samples, and measuring the aquifer water levels during system operations. The concentration of VOCs in the effluent water samples is monitored to ensure that the criteria for the no-longer-contained-in determination are met. Air effluent samples are collected to ensure that emission levels for VOCs are not exceeded. The purpose of water-level measurements is to demonstrate that the NPTF continues to capture the medial zone groundwater.

1.5.3 Distal Zone Remedial Action

Monitored natural attenuation is the treatment for the distal zone. The active portion of this treatment process is a combination of computer modeling and groundwater monitoring. Computer modeling has been used to predict that the concentration of COCs will decrease to below regulatory standards before the year 2095 using naturally occurring degradation processes. The computer models are based on the rate of TCE breakdown measured during previous groundwater-monitoring activities. Groundwater samples from wells located in the distal zone of the plume will be collected to verify that a sufficient decay rate is being maintained as predicted in the computer model.

Natural attenuation is a result of a combination of natural processes (e.g., rain, snowmelt, microbial activity, subsurface water flow, and chemical reactions). These processes naturally degrade and reduce contaminant concentrations in the groundwater. Monitoring is completed to ensure that the decay of contaminants occurs as predicted and is also used to track the extent of the contaminant plume boundaries.

Throughout the remedial action, groundwater will be monitored in accordance with the Phase C Groundwater Monitoring Plan (INEEL 2002a). The plan will consider and support the RAOs identified in the Record of Decision (DOE-ID 2001). Monitoring data will be used to track the >5-μg/L TCE plume, document COC concentration changes over time, provide information on the attenuation rate of the contaminants, and evaluate attainment of RAOs. The scope and requirements for groundwater monitoring are in the Phase C Groundwater Monitoring Plan (INEEL 2002a). Monitoring will be addressed in the MNA Remedial Action Work Plan when it is finalized in FY 2003.

1.5.4 Institutional Controls

Institutional controls (engineering and administrative controls) will be applied to protect current and future users from health risks associated with groundwater contamination by preventing ingestion of groundwater having concentrations of COCs exceeding MCLs or a cumulative risk of greater than 1×10^{-4}. The scope and requirements for institutional controls are addressed in the Phase C Groundwater Monitoring Plan (INEEL 2002a), ISB Operations and Maintenance Plan (DOE-ID 2002a), and the MNA Remedial Action Work Plan.

2. HAZARD IDENTIFICATION AND MITIGATION

The overall objective of this section is to identify existing and anticipated hazards based on the TAN OU 1-07B final groundwater remedial action scope of work and to provide controls to eliminate or mitigate these hazards. These include the following:

- Hazards associated with ISB system operations
  - Construction of the new ISB facility and well drilling activities will be controlled through Standard (STD) -101, "Integrated Work Control Process."
  - The ISB system operations are conducted in a dedicated facility that houses an electron donor storage area, pumps, and process piping. The main hazard is associated with handling the electron donor. Commercial vendors supply electron donor in 55- to 250-gal containers. Personnel need to take precautions when the electron donor is being moved or transported in support of ISB system operations. Refer to the applicable material safety data sheet for specific hazards to be encountered while handling specific electron donors.
- Hazards associated with ISB groundwater monitoring
  - Samples of groundwater are collected from hot spot monitoring wells in support of ISB. Workers handling ISB groundwater samples are potentially exposed to VOCs, direct radiation, radionuclide contamination, skin and eye irritants, and chemical compounds. Since an electrical generator is used to generate power for the groundwater sampling pumps, workers are also potentially exposed to gasoline and combustion products from the generator (such as carbon monoxide) as well as electrical hazards.
  - Samples collected in support of the ISB groundwater-monitoring program are either shipped offsite for analysis or are analyzed in the ISB field laboratory. Several chemicals are used to complete these onsite analyses and workers must comply with the personal protective equipment (PPE) requirements recommended for each chemical used in laboratory operations. Laboratory operations are described in Technical Procedure (TPR) -166, "ISB Field Analyses Procedure." A complete list of chemicals is provided in this procedure. Material safety data sheets for all chemicals used to support laboratory operations are available for reference.
- Hazards associated with the NPTF
  - Workers in the NPTF are potentially exposed to VOCs, industrial safety hazards, low-level radioactivity, noise, and back strain.
- Hazards associated with MNA and distal zone groundwater monitoring
  - Workers collecting groundwater samples in the distal zone of the plume have similar hazards as experienced by workers that collect ISB groundwater samples. These hazards include industrial safety hazards, VOCs, spills, leaks, and radionuclide contamination.

The magnitude of danger presented by these hazards to personnel entering work zones depends on both the nature of tasks being performed and the proximity of personnel to the hazards. Engineering controls will be implemented (whenever possible) along with administrative controls, work practices, and PPE to further mitigate potential exposures and hazards. This section describes the chemical, radiological, safety, and environmental hazards that personnel may encounter while conducting project tasks. Hazard mitigation provided in this section in combination with other work controls (e.g., TPRs, work orders, job safety analysis [JSA], and Guide [GDE] -6212, "Hazard Mitigation Guide for Integrated Work Control Process") will also be used, where applicable, to eliminate or mitigate project hazards.

2.1 Chemical and Radiological Hazards and Mitigation

Personnel may be exposed to chemical and radiological hazards while working at the TAN OU 1-07B final groundwater remedial action site. Table 2-1 lists the worker health-based chemical and radiological contaminants of concern that may be encountered while conducting project tasks. Table 2-2 lists the chemical and radiological contaminants of concern, associated exposure limits, routes of entry, target organs, level of carcinogen exposure, and matrix or source of contamination. Table 2-3 consists of a high-level summary of all OU 1-07B project activities and the associated mitigation strategies. This last table is not all-inclusive, as it does not include all specific work activities and mitigation strategies. Mitigation strategies for specific work activities are found in job-specific JSAs and technical procedures.

2.1.1 Routes of Exposure

Exposure pathways exist for hazardous materials and radionuclides at the OU 1-07B project site. Engineering controls, monitoring, training, and work controls will mitigate potential contact and uptake of these hazards; however, the potential for exposure to contaminants still exists. Exposure pathways include those listed below:

- **Inhalation** of VOCs and radionuclides is possible while handling contaminated groundwater or other contaminated media from the OU 1-07B site. Inhalation of contaminants can result in adverse effects, as listed in Table 2-2. In most cases, contaminant concentrations are not adequate to pose an inhalation hazard; however, precautions may be required to avoid inhalation of contaminants during specific work activities. These precautions will be covered in an appropriate work control document (JSA, TPR, etc.).

- **Skin absorption and contact** with contaminants are possible while handling contaminated groundwater or other contaminated media from the OU 1-07B site. Skin absorption of these materials can result in adverse affects, as listed in Table 2-2. Precautions and use of appropriate PPE are required to avoid skin absorption of the contaminants present in the materials encountered by OU 1-07B workers.

- **Ingestion** of VOCs and radionuclides is possible during OU 1-07B operations. Personnel shall not eat, drink, chew gum or tobacco, smoke, apply cosmetics, or perform any other practice that increases the probability of hand-to-mouth transfer of materials in any non-designated areas. Personnel shall wash hands and face after work is completed. As noted in Table 2-2, TCE and PCE are possible human carcinogens based on the results of animal studies. In addition, several of the radionuclides present in OU 1-07B project wastes are known human carcinogens. Respiratory protection required for specific jobs will be determined in consultation with the HSO and the project industrial hygienist (IH).

- **Injection** while handling contaminated groundwater or other contaminated media from the OU 1-07B project site by breaking of the skin or migration through an existing wound can result in localized irritation, contamination, uptake of soluble contaminants, and deposition of insoluble contaminants.

Table 2-1. Worker health-based chemical and radiological contaminants of concern.

Contaminant	Maximum Concentrations[a]	Federal Drinking Water Standard	Matrix or Source
VOLATILE ORGANIC COMPOUNDS			
TCE	12,000–32,000 ppb	5 ppb[b]	Groundwater
PCE	110 ppb	5 ppb[b]	Groundwater
cis-1,2-DCE	3,200–7,500 ppb	70 ppb[b]	Groundwater
Trans-1,2-DCE	1,300–3,900 ppb	100 ppb[b]	Groundwater
RADIONUCLIDES			
Tritium	14,900–15,300 pCi/L[c]	20,000 pCi/L	Groundwater
Strontium-90	530–1,880 pCi/L	8 pCi/L	Groundwater
Cesium-137	1,600–2,150 pCi/L	119 pCi/L[d]	Groundwater
Uranium-234	5.2–7.7 pCi/L[c]	27 pCi/L[e]	Groundwater

a. The concentration range is taken from measured concentrations at the TSF-05 injection well. Source: *Fiscal Year 1999 Groundwater Monitoring Annual Report Test Area North, Operable Unit 1-07B* (INEEL 2000).

b. Parts per billion (ppb) is a weight-to-weight ratio that is equivalent to micrograms per liter (µg/L) in water.

c. Maximum concentrations of tritium and U-234 are below federal drinking water standards and baseline risk calculations indicate cancer risk of 3×10^{-6}. While this risk is smaller than 1×10^{-4}, both tritium and U-234 are included as COCs as a comprehensive plume management strategy.

d. The maximum contaminant level for Cs-137 is derived from a limit of 4 mrem/yr cumulative dose equivalent to the public, assuming a lifetime intake of 2 L per day of water.

e. The federal drinking water standard for U-234 is for the U-234, U-235, and U-238 series.

COC = contaminant of concern
DCE = dichloroethene
INEEL = Idaho National Engineering and Environmental Laboratory
PCE = tetrachloroethene
TCE = trichloroethene
ppb = parts per billion
pCi/L = picocuries per liter

Chemical and radiological hazards will be eliminated, isolated, or mitigated to the extent possible during all project tasks. Where they cannot be eliminated or isolated, monitoring for chemical and radiological hazards will be conducted (as described in Section 3) to detect and quantify exposures. In addition, administrative controls, training, work procedures, and protective equipment will be used to further reduce the likelihood of exposure to these hazards. (See Table 2-3 for a summary of each primary project task, associated hazards, and mitigation procedures.)

The JSA and radiological work permit (RWP) may be used in conjunction with this HASP to address specific hazardous operations (e.g., hot work) and radiological conditions at the project site. If used, these permits will further detail specialized PPE and dosimeter requirements.

2.2 Safety and Physical Hazards and Mitigation

Industrial and physical hazards will be encountered while performing ISB operations, NPTF operations, and groundwater sampling at the OU 1-07B project site. Section 4.2 provides general safe-work practices that must be followed at all times. The following sections describe specific industrial safety hazards and the associated procedures to be followed to eliminate or minimize potential hazards to project personnel.

Table 2-2. Evaluation of health-based contaminants of concern at the Operable Unit 1-07B site.

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Volatile Organic Compounds—PCE, TCE, and DCE						
PCE	ACGIH TLV—25 ppm, 170 mg/m^3 TWA ACGIH STEL—100 ppm, 685 mg/m^3 OSHA PEL—100 ppm TWA	Skin, ingestion for liquids; inhalation for gaseous state.	Irritates eyes, nose, throat; nausea, flushed face, neck; vertigo, dizziness, uncoordination, headache, drowsiness, flushed skin, liver damage; liver tumors in animals.	Liver, kidneys, eyes, skin, upper respiratory system, CNS	Possible human carcinogen IARC—2A NIOSH—Ca NTP—R	Gas vapor or liquid that may be dissolved in water or adsorbed onto activated carbon
TCE	ACGIH TLV—50 ppm, 269 mg/m^3 TWA ACGIH STEL—100 ppm, 537 mg/m^3 OSHA PEL—100 ppm TWA OSHA CIEL—200 ppm	Skin, ingestion for liquids; inhalation for gaseous state.	CNS/headache, vertigo, vision disturbance, tremors, somnolence (drowsiness), nausea, vomiting, eye irritation, dermatitis, cardiac arrhythmia, paresthesia.	Irritates eyes and skin; respiratory system, heart, liver, kidneys, CNS	Possible human carconigen IARC—2A NIOSH—Ca NTP—R	Gas vapor or liquid that may be dissolved in water or adsorbed onto activated carbon
DCE	AGGIH TLV—200 ppm, 793 mg/m^3 TWA OSHA PEL—200 ppm, 790 mg/m^3	Skin, ingestion for liquids; inhalation for gaseous state.	Irritates eyes, respiratory system; CNS depression.	Eyes, respiratory system, CNS	Not a carcinogen	Gas vapor or liquid that may be dissolved in water or adsorbed onto activated carbon

Table 2-2. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Radionuclides—Sr-90, Am-241, Cs-137, U-234, U-235, U-238, Co-60, Pu-238, Pu-239, Pu-240, tritium (H-3) (dominant radioisotopes, 99.9% of radioactivity at TAN OU 1-07B final groundwater remedial action site)						
Sr-90	DAC—2.0 E-9 μCi/mL Lung Retention Class Y	Inhalation, ingestion, skin	—	Gastrointestinal system, red marrow, bone surfaces, CNS	Carcinogenic, mutagenic	Ionic state dissolved in water or as precipitate inside lines/vessels
Am-241	DAC—2.0 E-12 μCi/mL Lung Retention Class W	Inhalation, ingestion, skin	—	Gonads, red marrow, bone surfaces, liver	Carcinogenic, mutagenic	Ionic state dissolved in water or as precipitate inside lines/vessels
Cs-137	DAC—7.0 E-8 μCi/mL Lung Retention Class D	Inhalation, ingestion	Hyperirritability	Spleen, kidney, and cellular damage to soft tissues	Carcinogenic, mutagenic	Ionic state dissolved in water or as precipitate inside lines/vessels
U-234 U-235 U-238	DAC—2.0 E-11 μCi/mL Lung Retention Class Y	Inhalation, ingestion	—	Bone cellular damage (red marrow and bone surface), kidneys, and lungs	Carcinogenic, mutagenic	Ionic state dissolved in water or as precipitate inside lines/vessels or in resins
Co-60	DAC—1.0 E-8 μCi/mL Lung Retention Class Y	Inhalation, ingestion, skin	—	Lungs, skin, heart, liver, kidneys, and blood	Carcinogenic, mutagenic	Ionic state dissolved in water or as precipitate inside lines/vessels or in resins
Pu-238	DAC—7.0 E-12 μCi/mL Lung Retention Class Y	Inhalation, ingestion, skin	—	Bone surfaces	—	—
Pu-239	DAC—6.0 E-12 μCi/mL Lung Retention Class Y	—	—	—	—	—

Table 2-2. (continued).

Material or Chemical (CAS No., Vapor Density, and Ionization Energy)	Exposure Limit[a] (Permissible Exposure Limit and Threshold Limit Value)	Routes of Exposure	Symptoms of Overexposure[b] (Acute and Chronic)	Target Organs and System	Carcinogen? (Source)[c]	Matrix or Source at Project Site
Pu-240	DAC—6.0 E-12 μCi/mL Lung Retention Class Y	—	—	—	—	—
Tritium (H-3)	DAC Water—2.0 E-5 μCi/mL Lung Retention Class Y DAC Elemental—5.0 E-1 μCi/mL Lung Retention Class Y	Inhalation, ingestion, skin	—	Whole body	—	—
Radionuclides (whole-body exposure)	As stated in limiting condition section of radiological work permit	—	—	Blood-forming cells, gastrointestinal tract, and rapidly dividing cells	Yes	Source in waste and in surface soils

a. Sources: *Threshold Limit Values Booklet for Chemical Substances and Physical Agents* (ACGIH 2001) and substance-specific standards (29 CFR 1910).

b. These include (1) nervous system: dizziness, nausea, and lightheadedness; (2) dermis: rashes, itching, and redness; (3) respiratory system: respiratory effects; and (4) eyes: tearing and irritation.

c. If yes, identify agency and appropriate designation (i.e., ACGIH A1 or A2, NIOSH, OSHA, IARC, NTP).

ACGIH = American Conference of Governmental Industrial Hygienists
CNS = central nervous system
DAC = derived air concentration
DCE = dichloroethene
IARC = International Agency for Research on Cancer
NIOSH = National Institute of Occupational Safety and Health
NTP = National Toxicology Program
OSHA = Occupational Safety and Health Administration
PCE = tetrachloroethene
PEL = permissible exposure limit

Table 2-3. Summary of Operable Unit 1-07B project activities, associated hazards, and mitigation.

Activity or Task	Associated Hazards or Hazardous Agents	Hazard Mitigation
Treatment facility normal operations and water sampling (ASTU, NPTF)	Organic vapor exposure, industrial safety hazards, potential exposure to low-level radioactivity, noise, radionuclide contamination, back strain, heat and cold stress, and heavy lifting	Industrial hygienist monitoring, trained operators, JSAs, TPRs, qualified heavy equipment operator, qualified groundwater samplers, designated traffic lanes and areas, watch body position, work-rest cycles as required, and wear PPE.
Hydrologic tracer tests	Organic vapor exposure and potential exposure to low-level radioactivity, spills, leaks, industrial hazards, heat and cold stress, and heavy lifting	Industrial hygienist monitoring, radiological control technician surveys, RWP (as required), spill prevention, spill kits, qualified operators, qualified samplers, qualified equipment operators, work-rest cycles as required, wear PPE, and watch body position.
Characterization sampling	Organic vapor exposure, potential exposure to low-level radioactivity, spills, industrial safety hazards, heat and cold stress, and heavy lifting	Industrial hygienist monitoring, radiological control technician surveys, RWP (as required), spill prevention, spill kits, qualified samplers, work-rest cycles as required, watch body position, and wear PPE.
Equipment decontamination (including spills)	Organic vapor exposure, potential exposure to low-level radioactivity, industrial safety hazards, noise, heat and cold stress, and heavy lifting	Industrial hygienist monitoring, radiological control technician surveys, RWP (as required), qualified operators, work-rest cycles as required, watch body position, and wear PPE.
Handling and packaging spent carbon, ion exchange resin, multimedia filters, bag filters, and CERCLA waste	Organic vapor exposure, potential exposure to low-level radioactivity, direct radiation, spills, leaks, industrial safety hazards, noise, heat and cold stress, and heavy lifting	Industrial hygienist monitoring, radiological control technician surveys, RWP (as required), spill prevention, spill kits, qualified operators, qualified samplers, qualified equipment operators, work-rest cycles as required, wear PPE, and watch body position.
Maintenance of treatment system components	VOCs, spills, leaks, direct radiation, and potential exposure to low-level radioactivity, noise, heat and cold stress, and heavy lifting	Industrial hygienist monitoring, radiological control technician surveys, RWP (as required), spill prevention, spill kits, qualified operators, qualified samplers, qualified equipment operators, work-rest cycles as required, wear PPE, and watch body position.
CERCLA waste inspections	VOCs, spills, leaks, industrial safety hazards, direct radiation, and potential exposure to low-level radioactivity and heat and cold stress	Industrial hygienist monitoring, radiological control technician surveys, spill prevention, spill kits, qualified inspectors, work-rest cycles as required, and wear PPE.
Field laboratory analysis work	Potential exposure to low-level radioactivity, gas cylinders, containerized gases, industrial safety hazards, heat and cold stress, and heavy lifting	Industrial hygienist monitoring, radiological control technician surveys, spill prevention, spill kits, qualified technicians, work-rest cycles as required, watch body position, and wear PPE.
System upgrades/hardware replacement (valves, pumps, tanks, piping, solids removal equipment, etc.)	VOCs, spills, leaks, industrial safety hazards, direct radiation, and potential exposure to low-level radioactivity, noise, heat and cold stress, and heavy lifting	Industrial hygienist monitoring, radiological control technician surveys, RWP (as required), spill prevention, spill kits, qualified operators, qualified equipment operators, work-rest cycles as required, wear PPE, and watch body position.

Table 2-3. (continued).

Activity or Task	Associated Hazards or Hazardous Agents	Hazard Mitigation
Treatment facility construction (steel erection, pipe fabrication, civil, etc.)	Industrial/construction safety hazards	Industrial hygienist monitoring, qualified construction personnel, work-rest cycles as required, wear PPE, and watch body position.
Construction tie-ins to existing lines	Industrial/construction safety hazards, VOCs, direct radiation, radionuclide contamination, spills, and leaks	Industrial hygienist monitoring, radiological control technician surveys, RWP (as required), spill prevention, spill kits, qualified construction personnel, qualified equipment operators, work-rest cycles as required, wear PPE, and watch body position.
Field tests and well pumping tests in support of treatability study field evaluations	Overhead hazards, industrial safety hazards, VOCs, direct radiation, radionuclide contamination spills, strong oxidizers, leaks, noise, heat and cold stress, and heavy lifting	Identify specific overhead hazards applicable to job and apply mitigation strategies, industrial hygienist monitoring, radiological control technician surveys, RWP (as required), spill prevention, spill kits, qualified samplers, qualified equipment operators, work-rest cycles as required, wear PPE, and watch body position.
Groundwater monitoring (monthly, quarterly, and annual sampling activities)	Industrial safety hazards, VOCs, direct radionuclides, spills, leaks, radionuclide contamination, noise, heat and cold stress, and heavy lifting	Industrial hygienist monitoring, radiological control technician surveys, RWP (as required), spill prevention, spill kits, qualified samplers, sampling procedures, qualified equipment operators, work-rest cycles as required, wear PPE, and watch body position.
Well drilling	Overhead hazards, industrial/construction safety hazards, heavy lifting, VOCs, direct radiation, spills, leaks, radionuclide contamination, noise, skin and eye irritants, chemical compounds, noise, heat and cold stress, gas cylinders, welding and cutting, hoisting and rigging, falls, rotating equipment, and fire	Industrial hygienist monitoring, radiological control technician surveys, RWP (as required), spill prevention, spill kits, work control, qualified operators, qualified samplers, qualified equipment operators, work-rest cycles as required, gas cylinder training, qualified welders, use fall protection as required, avoid unguarded rotating equipment, comply with company hoisting and rigging requirements, wear PPE, and watch body position.

ASTU = air stripper treatment unit
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
JSA = job safety analysis
NPTF = New Pump and Treat Facility
PPE = personal protective equipment
TPR = technical procedure
VOC = volatile organic compound

2.2.1 Material Handling and Back Strain

Material handling, maneuvering of various pieces of equipment, groundwater sampling, and field laboratory work may result in employee injury. All lifting and material-handling tasks will be performed in accordance with Management Control Procedure (MCP) -2692, "Preventing Ergonomic and Back Disorders." Personnel will not physically lift objects weighing more than 22 kg (50 lb) or 33% of their body weight (whichever is less) alone. In addition, back strain and ergonomic considerations must be given to material handling and equipment usage. Mechanical and hydraulic lifting devices should be used to move materials whenever possible. The IH will conduct ergonomic evaluations of various project tasks to determine the potential ergonomic hazards and provide recommendations to mitigate these hazards. Applicable requirements from Program Requirements Document (PRD) -2016 or MCP-2739, "Material Handling, Storage, and Disposal," will also be followed.

2.2.2 Repetitive Motion and Musculoskeletal Disorders

Field laboratory analysis work tasks to be conducted may expose personnel to repetitive-motion hazards, undue physical stress, overexertion, awkward postures, or other ergonomic risk factors that may lead to musculoskeletal disorders. Musculoskeletal disorders can cause a number of conditions including pain, numbness, tingling, stiff joints, difficulty moving, muscle loss, and sometimes paralysis. The assigned project IH will evaluate project tasks and provide recommendations to reduce the potential for musculoskeletal disorders in accordance with MCP-2692.

2.2.3 Working and Walking Surfaces

Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, slips, and falls. The OU 1-07B project site presents inherent tripping hazards because of uneven walking surfaces such as gravel roads and paths. In addition, the potential for slip, trip, and fall hazards will increase during winter months because of ice- and snow-covered surfaces combined with objects beneath the snow. During the pre-job briefing, all personnel will be made aware of tripping hazards that cannot be eliminated. Tripping and slip hazards will be evaluated during the course of the project in accordance with PRD-2005 or PRD-5103, "Walking and Working Surfaces."

2.2.4 Elevated Work Areas

Personnel may sometimes be required to work on elevated equipment or at heights above 1.8 m (6 ft). During such work, employees will comply with requirements from PRD-2002 or PRD-5096, "Fall Protection," and applicable requirements from PRD-2006 or MCP-2709, "Aerial Lifts and Elevating Work Platforms"; PRD-2003, "Ladders"; PRD-2004 or PRD-5098, "Scaffolding"; and PRD-2005 or PRD-5103, "Walking and Working Surfaces." Where required, a fall protection plan will be written.

2.2.5 Powered Equipment and Tools

Powered equipment and tools present potential physical hazards (e.g., pinch points, electrical hazards, flying debris, struck-by hazards, and caught-between hazards) to personnel operating them. All portable equipment and tools will be properly maintained and used by qualified individuals and in accordance with the manufacturer's specifications. At no time will safety guards be removed. Requirements from PRD-2015, "Hand and Portable Power Tools," or PRD-5101, "Portable Equipment and Handheld Power Tools," will be followed for all work performed with powered equipment including hand tools. The user will inspect all tools before use.

2.2.6 Electrical Hazards and Energized Systems

Electrical equipment and tools, as well as overhead and underground lines associated with OU 1-07B construction or operations, could pose shock or electrocution hazards to personnel. Safety-related work practices will be employed to prevent electric shock or other injuries resulting from direct or indirect electrical contact. If work on energized systems is necessary, these practices will conform to the requirements in PRD-2011 or PRD-5099, "Electrical Safety"; MCP-3650, "Chapter IX Level I Lockout and Tagouts"; MCP-3651, "Chapter IX Level II Lockouts and Tagouts"; and Parts I through III of the National Fire Protection Association (NFPA) 70E. In addition, all electrical work will be reviewed and completed under the appropriate work controls (e.g., TPRs and work orders). When working around overhead lines, clearances will be maintained at all times. In addition, all underground utilities and installations will be identified before conducting excavation activities in accordance with PRD-2014, "Excavation and Surface Penetrations."

2.2.7 Fire and Flammable Materials Hazards

Fuel will be required for driving vehicles and occasional operation of electrical generators used to facilitate groundwater sampling or to provide backup power to the NPTF or ISB system. Flammable hazards may include (1) transfer and storage of flammable or combustible liquids in the OU 1-07B project area. Portable fire extinguishers with a minimum rating of 10A/20BC will be strategically located at the project site to combat Class ABC fires. They will be located in all active construction and operations areas, on or near all facility equipment that has exhaust heat sources, and on or near all equipment capable of generating ignition or having the potential to spark. Guidance from MCP-2707, "Compatible Chemical Storage," will be consulted when storing chemicals.

2.2.7.1 Combustible Materials. Combustible or ignitable materials in contact with or near exhaust manifolds, catalytic converters, or other ignition sources could result in a fire. A fire protection engineer should be contacted if questions arise about potential ignition sources. The accumulation of combustible materials will be strictly controlled. Class A combustibles (such as trash, cardboard, rags, wood, and plastic) will be properly disposed of in appropriate waste containers. The fire protection engineer may also conduct periodic site inspections to ensure that all fire protection requirements are being met.

2.2.7.2 Flammable and Combustible Liquids. Fuel used at the site for fueling must be safely stored, handled, and used. Only flammable liquid containers approved by the Factory Mutual and Underwriters Laboratories and labeled with the contents will be used to store fuel. All fuel containers will be stored at least 15 m (50 ft) from any facilities and ignition sources or they will be stored inside an approved flammable storage cabinet. Additional requirements are provided in PRD-2201, "Flammable and Combustible Liquid Storage," or MCP-584, "Flammable and Combustible Liquid Storage and Handling." Portable motorized equipment (e.g., generators and light plants) will be shut off and allowed to cool down in accordance with the manufacturer's operating instructions before being refueled to minimize the potential for a fuel fire.

2.2.7.3 Welding, Cutting, or Grinding. Personnel conducting welding, cutting, or grinding tasks may be exposed to molten metal, slag, and flying debris. In addition, a fire potential exists if combustible materials are not cleared from the work area. Requirements from PRD-2010 or PRD-5110 "Welding, Cutting, and Other Hot Work," will be followed whenever these types of activities are conducted.

2.2.8 Pressurized Systems

In order to support groundwater-monitoring activities, FLUTe liners will be operated at the project site. The hazards presented to personnel, equipment, facilities, or the environment because of inadequately designed or improperly operated pressure (or vacuum) systems include blast effects, shrapnel, fluid jets, release of toxic or asphyxiant materials, contamination, equipment damage, personnel injury, and death. These systems can include pneumatic, hydraulic, vacuum, or compressed gas systems. The requirements of PRD-2009, "Compressed Gases," and the manufacturer's operating and maintenance instructions must be followed.

All pressure systems will be operated in the designed operating pressure range, which is typically 10 to 20% less than the maximum allowable working pressure. In addition, all hoses, fittings, lines, gauges, and system components will be rated for the system for at least the maximum allowable working pressure (generally the relief set point). The project safety professional should be consulted about any questions of pressure systems in use at the project site.

2.2.9 Compressed Gases

The FLUTe liner sampling activities as well as oxy-acetylene cutting associated with drill rig maintenance and casing sizing require the use of compressed gases. All cylinders will be used, stored, handled, and labeled in accordance with PRD-2009. In addition, the safety professional should be consulted about any compressed gas cylinder storage, transport, and usage issues.

2.2.10 Heavy Equipment and Moving Machinery

Hazards associated with the operation of heavy equipment include injury to personnel (e.g., struck-by and caught-between hazards) and equipment and property damage. All heavy equipment will be operated in the manner in which it was intended and in accordance with the manufacturer's instructions. Only authorized, qualified personnel will be allowed to operate equipment, and personnel near operating heavy equipment must maintain visual communication with the operator. Personnel will comply with PRD-2020 or MCP-2745, "Heavy Industrial Vehicles," and PRD-2019, "Motor Vehicle Safety."

Personnel working around or near cranes or boom trucks will also comply with PRD-2002, "Fall Protection," or Plan (PLN) -159, "Hoisting and Rigging Implementation Plan," (as applicable and appropriate).

Additional safe practices will include the following:

- All heavy equipment will have backup alarms.
- Walking directly behind or to the side of heavy equipment without the operator's knowledge is prohibited. All precautions will be taken before moving heavy equipment.
- While operating heavy equipment in the work area, the equipment operator will maintain communication with a designated person who will be responsible for providing direct voice contact or approved standard hand signals. In addition, all facility personnel in the immediate work area will be made aware of the equipment operations.
- All equipment will be kept out of traffic lanes and access ways and will be stored so as not to endanger personnel at any time.
- All unattended equipment will have appropriate reflectors or be barricaded if left on roadways.

- All parked equipment will have the parking brake set and chocks will be used when equipment is parked on inclines.

- The swing radius of heavy equipment will be adequately barricaded or marked to prevent personnel from entering into the swing radius.

2.2.11 Excavation, Surface Penetrations, and Outages

Excavation activities will be conducted in conjunction with well construction, well maintenance, and construction activities. All surface penetrations and related outages will be coordinated through TAN facilities and will require submittal of an outage request (i.e., Form 433.01, "Outage Request") for outages (e.g., road, electrical, and water). The submission of an outage request will not be considered an approval to start the work. Other specific outage requirements are addressed in the "Special conditions" section of the management and operating contract. No surface penetrations will be allowed or conducted until the area has been evaluated and an approved subsurface evaluation has been documented.

All excavation activities will be conducted and monitored in accordance with PRD-2014 or PRD-22, "Excavation and Surface Penetrations," and 29 CFR 1926, Subpart P, "Excavations." The following are some key elements from these requirements:

- The location of utility installations (e.g., sewer, telephone, fuel, electric, water lines, or any other underground installations) that may reasonably be expected to be encountered during excavation work will be determined before opening an excavation.

- Structural ramps that are used solely by employees as a means of access or egress from excavations will be designed by a competent person. Structural ramps used for access or egress of equipment will be designed by a competent person qualified in structural design and will be constructed in accordance with the design. Structural ramps will be inspected in accordance with Form 432.57, "Excavation Checklist."

- Employees exposed to public vehicular traffic will be provided with and will wear warning vests or other suitable garments marked with or made of reflecting or high-visibility material.

- Daily inspections of excavations, areas adjacent to the excavations, and protective systems will be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection will be conducted by the competent person before the start of work and as needed throughout the shift. Inspections will also be made after every rainstorm or other hazard-increasing occurrence.

- Sloping or benching will be constructed and maintained in accordance with the requirements set forth in 29 CFR 1926, Subpart B, Appendix B, for the soil type as classified by the competent person. This classification of the soil deposits will be made based on the results of at least one visual inspection and at least one manual analysis.

2.2.12 Hoisting and Rigging of Equipment

All hoisting and rigging associated with completion of OU 1-07B project tasks (such as well maintenance and construction) will be performed in accordance with PRD-2007 or PLN-159 and DOE-STD-1090-01, "Hoisting and Rigging," as applicable. Hoisting and rigging equipment will show evidence of a current inspection (e.g., tag) and be inspected before use by qualified personnel. In addition, the operator or designated person for mobile cranes or boom trucks will perform a visual inspection each day or before use (if the crane has not been in regular service) of items such as, but not limited to, the following:

- All control mechanisms for maladjustment that would interfere with proper operation
- Crane hooks and latches for deformation, cracks, and wear
- Hydraulic systems for proper oil level
- Lines, tanks, valves, pumps, and other parts of air or hydraulic systems for leakage
- Hoist ropes for kinking, crushing, bird caging, and corrosion
- All anti-two-block, two-block warning, and two-block damage prevention systems for proper operation.

> **Note:** The operator or other designated person will examine deficiencies and determine whether they constitute a safety hazard. If deficiencies are found, they will be reported to the safety professional.

2.2.12.1 Drilling Hazards. Rotary air blast, air core, diamond, reverse circulation, rotary (mud), auger, direct push, or sonic drilling will be used at the project site to drill groundwater wells to the required depths, as described in Section 1. Drilling personnel will be aware of potential drilling equipment hazards and body positioning during all material-handling tasks. Specific hazards associated with drill rigs are described below.

2.2.12.1.1 Slips (Toothed Wedges)—Slips are toothed wedges positioned between the drill pipe and the master bushing or rotary table to suspend the drill string in the well bore when it is not supported by the hoist. Most accidents associated with slip operations are related to manual material handling. Strained backs and shoulders are common.

2.2.12.1.2 Tongs—Tongs are large, counter-weighted wrenches used to break apart torqued couplings on the drill pipe. Both sets of tongs have safety lines; when breakout force is applied to the tongs, the tongs or the safety lines could break and injure a worker standing near them. Accidents can occur when the driller activates the wrong tong lever and an unsecured tong swings across the rig floor at an uncontrolled velocity. A common accident attributable to tongs can occur when a worker has a hand or finger in the wrong place while attempting to swing and latch the tong onto the drill pipe, resulting in crushing injuries to or amputation of the fingers.

2.2.12.2 Elevators. Elevators are a set of clamps affixed to the bails on the swivel below the traveling block. They are clamped to each side of a drill pipe and hold the pipe as it is pulled from the well bore. Accidents and injuries can occur during the latching and unlatching tasks; fingers and hands can be caught and crushed in the elevator latch mechanism. If the pipe is overhead when the latching mechanism fails, the pipe may fall on workers working on the drill floor.

2.2.12.3 Catlines. Catlines are used on drilling rigs to hoist material. Accidents that occur during catline operations may injure the worker doing the rigging as well as the operator. Minimal control over hoisting materials can cause sudden and erratic load movements, which may result in hand and foot injuries.

2.2.12.4 Working Surfaces. The rig floor is the working surface for most tasks performed in well drilling operations. The surface is frequently wet from circulating fluid, muddy cuttings, and water used or removed from the borehole during drilling operations. Slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, slips, and falls.

2.2.12.5 Material Handling. The most common type of accident that occurs during material handling is when a load is being handled and a finger or toe is caught between two objects. Rolling stock can shift or fall from a pipe rack or truck bed. Fingers and hands can be caught between sampling barrels, breakout vices, and tools.

2.2.12.6 High-Pressure Lines. A high-pressure diversion system will be used to carry cuttings away from the borehole. All high-pressure lines will be equipped with positive locking connectors (e.g., cams) and be secured with properly rated whip checks in case of a connection failure. The project safety professional will be consulted about the rating and proper placements of whip checks or equivalent restraining devices.

2.2.13 Overhead Objects

Personnel may be exposed to falling overhead objects, debris, or equipment or impact hazards during the course of the project. Sources for these hazards will be identified and mitigated in accordance with PRD-2005 or PRD-5103. In the case of overhead impact hazards, they will be marked by using engineering-controls protective systems where there is a potential for falling debris, in combination with head protection PPE.

2.2.14 Personal Protective Equipment

Wearing PPE will reduce a worker's ability to move freely, see clearly, and hear directions and noise that might indicate a hazard. In addition, PPE can increase the risk of heat stress. Work activities at the task site will be modified as necessary to ensure that personnel are able to work safely in the required PPE. Work-site personnel will comply with PRD-2001, "Personal Protective Equipment," and MCP-432, "Radiological Personal Protective Equipment." All personnel who wear PPE will be trained in its use and limitations in accordance with PRD-2001.

2.2.15 Decontamination

Decontamination procedures for personnel and equipment are detailed in Section 11. Potential hazards to personnel conducting decontamination tasks include back strain; slip, trip, and fall hazards; and cross-contamination from contaminated surfaces. In addition, electrical hazards may be present if powered equipment (e.g., a powered pressure washer) is used. Mitigation of these walking/working surfaces and electrical hazards is addressed in other prior subsections. If a power washer or heated power washer is used, units will be operated in accordance with the manufacturer's operating instructions, personnel will wear appropriate PPE to prevent high-pressure spray injuries, use ground-fault circuit protection, and these tasks will only be conducted in approved areas. Personnel will wear required PPE at all times during decontamination tasks, as listed in Section 5.

2.3 Environmental Hazards and Mitigation

Potential environmental hazards will present potential hazards to personnel during project tasks. These hazards will be identified and mitigated to the extent possible. This section describes these environmental hazards and states which procedures and work practices will be followed to mitigate them.

2.3.1 Noise

Personnel involved in project activities may be exposed to noise levels in the NPTF that exceed 85 decibel A-weighted (dBA). However, personnel working in the NPTF are not expected to be exposed to noise that exceeds 85 dBA for an 8-hour time-weighted average (TWA) or 84 dBA for a 10-hour TWA. The effects of high sound levels (noise) may include the following:

- Personnel being startled, distracted, or fatigued
- Physical damage to the ear and pain and temporary or permanent hearing loss
- Interference with communication that would warn of danger.

Noise measurements have been performed in the past and will continue to be performed in accordance with PRD-2108, "Hearing Conservation," or MCP-2719, "Controlling and Monitoring Exposures to Noise," to determine if personnel are routinely exposed to noise levels in excess of the applicable TWA (85 dBA for 8-hour exposures or 84 dBA for 10-hour exposures).

Personnel whose noise exposure routinely meets or exceeds the allowable TWA will be enrolled in the INEEL Occupational Medical Program (OMP) or subcontractor hearing conservation program, as applicable. Personnel working on jobs that have noise exposures greater than 85 dBA (84 dBA for a 10-hour TWA) will be required to wear hearing protection until noise levels have been evaluated and will continue to wear the hearing protection specified by the IH until directed otherwise. Hearing protection devices will be selected and worn in accordance with PRD-2108 or MCP-2719.

2.3.2 Heat and Cold Stress

Groundwater sampling and construction tasks will be conducted during times when there is a potential for heat or cold stress that could present a potential hazard to personnel. The IH or HSO will be responsible for obtaining meteorological information to determine if additional heat or cold stress administrative controls are required. All project personnel must understand the hazards associated with heat and cold stress and take preventive measures to minimize the effects. Heat and cold stress (PRD-2107 or MCP-2704) guidelines will be followed when determining work-rest schedules or when to halt work activities because of temperature extremes.

2.3.3 Heat and Cold Stress

Employees may be required to work outdoors during summer months or wear protective clothing that prevents the body from cooling. High or extreme internal body temperatures can result in heat fatigue, heat exhaustion, or heat stroke that can lead to symptoms from physical discomfort up to and including death. Employees who experience any signs or symptoms of heat stress or who observe a fellow employee (buddy) experiencing them must inform the field construction coordinator (FCC) or HSO. Heat stress hazards are discussed in MCP-2704, "Controlling Exposure to Heat and Cold Stress"; PRD-2107, "Heat and Cold Stress"; and MCP-9240, "Managing Heat and Cold Stress at TAN."

Heat and cold stress conditions will be monitored according to MCP-2704, "Controlling Exposure to Heat and Cold Stress"; PRD-2107, "Heat and Cold Stress"; and MCP-9240 "Managing Heat and Cold Stress at TAN" (as applicable). Depending on weather conditions, work conditions, type of PPE worn, and the physical response of work operations employees, the IH/radiological control technician (RCT) will inform the FCC of necessary adjustments to the work/rest cycle. A supply of cool drinking water will be provided, as necessary, at the task site and consumed only in the support zone (SZ) or outside of the

OU 1-07B project area. The IH/RCT or HSO may periodically interview workers to ensure that the controls are effective and that excessive heat or cold exposure is not occurring. A cool-down area will be designated where workers can rest periodically. Workers will be encouraged to monitor body signs and to take breaks if symptoms of heat or cold stress occur.

Relatively cool ambient temperatures and wet or windy conditions increase the potential for cold injury to employees. The INEEL safety and health manuals; MCP-2704, "Controlling Exposure to Heat and Cold Stress"; PRD-2107, "Heat and Cold Stress"; and MCP-9240, "Managing Heat and Cold Stress at TAN," discuss the hazards of cold stress.

2.3.3.1 Ultraviolet Light Exposure. Personnel will be exposed to ultraviolet (UV) light (i.e., sunlight) when conducting project tasks. Sunlight is the main source of UV light known to damage the skin and to cause skin cancer. The amount of UV light exposure depends on the strength of the light, the length of exposure, and whether the skin is protected. No UV rays or suntans are safe. The following are suggested mitigative actions to take to minimize UV light exposure:

- Wear clothing to cover the skin (long pants [no shorts] and long-sleeve or short-sleeve shirt [no tank tops])
- Use a sunscreen with a sun protection factor of at least 15
- Wear a hat (hard hat where required)
- Wear UV-absorbing safety glasses
- Limit exposure during peak intensity hours of 10 a.m. to 4 p.m. whenever possible.

Note: The previous suggestions are not requirements and should only be viewed as recommendations.

2.3.4 Inclement Weather Conditions

When inclement or adverse weather conditions develop that may pose a threat to persons or property at the project site (e.g., sustained strong winds 25 mph or greater, electrical storms, heavy precipitation, or extreme heat or cold), conditions will be evaluated and a decision made by the HSO with input from other personnel to halt work, employ compensatory measures, or proceed. The FTL and HSO will comply with INEEL MCPs and facility work control documents that specify limits for inclement weather.

2.3.5 Subsidence

Personnel may be exposed to subsidence hazards from trenches or uncompacted, backfilled excavation areas during project activities. This is primarily an equipment hazard when driving or operating equipment in subsidence areas; however, personnel may also be at risk from walking in these areas. Where required, personnel will not enter potential subsidence areas until they obtain clearance from the area supervisor or facility shift supervisor (SS). Barriers and postings for potential subsidence areas will be observed at all times.

2.3.6 Biological Hazards

The INEEL is located in an area that provides habitat for various rodents, insects, and vectors (i.e., organisms that carry disease-causing microorganisms from one host to another). The potential exists for encountering nesting materials or other biological hazards and vectors. The Hantavirus may be present in the nesting and fecal matter of deer mice. If such materials are disturbed, they can become airborne and create a potential inhalation pathway for the virus. Contact and improper removal of these materials may provide additional inhalation exposure risks.

If suspected rodent nesting or excrement material is encountered, the IH will be notified immediately and **no attempt will be made to remove or clean the area**. Following an evaluation of the area, disinfection and removal of such material will be conducted in accordance with MCP-2750, "Preventing Hantavirus Infection."

Snakes, insects, and arachnids (e.g., spiders, ticks, and mosquitoes) may also be encountered. Common areas to avoid include material stacking and staging areas, under existing structures (e.g., trailers and buildings), under boxes, and other areas that provide shelter. Protective clothing will generally prevent insects from direct contact with the skin. If potentially dangerous snakes or spiders are found or are suspected of being present, warn others, keep clear, and contact the IH or HSO for additional guidance (as required).

Insect repellant (DEET or equivalent) may be required. Areas where standing water has accumulated (e.g., evaporation ponds) provide breeding grounds for mosquitoes and should be avoided. In cases where a large area of standing water is encountered, it may be necessary to pump the water out of the declivity (areas other than the evaporation ponds).

2.3.7 Confined Spaces

Work in confined spaces may subject personnel to risks involving engulfment, entrapment, oxygen deficiency, and toxic or explosive atmospheres. Several confined spaces have been identified at the project site. These confined spaces have been determined to be permit-required confined spaces. If entry into a confined space is required to complete project work activities, then all requirements of MCP-2749, "Confined Spaces," will be followed.

2.4 Other Task-Site Hazards

Task-site personnel should continually look for potential hazards and immediately inform the field team leader (FTL) or HSO of the hazards so that action can be taken to correct the condition. All personnel have the authority to initiate STOP WORK actions in accordance with PRD-1004 or MCP-553, "Stop Work Authority," if it is perceived that an imminent safety or health hazard exists or take corrective actions within the scope of the work control authorization documents to correct minor safety or health hazards and then inform the FTL.

Personnel working at the task site are responsible for using safe-work practices, reporting unsafe working conditions or acts, and exercising good housekeeping habits with respect to tools, equipment, and waste throughout the course of the project.

2.5 Site Inspections

Project personnel may participate in site inspections during the work control preparation stage (such as the hazard identification and verification walk downs) and conduct self-assessments or other inspections. In addition, the HSO, project manager, or FTL will perform periodic safety inspections in accordance with MCP-3449, "Safety and Health Inspections."

Targeted or required self-assessments may be performed during investigation and sampling operations in accordance with MCP-8, "Self-Assessment Process for Continuous Improvement." All inspections and assessments will be documented and available for review by the FTL. These inspections will be noted in the applicable FTL or construction engineer logbook. Health and safety professionals present at the task site may, at any time, recommend changes in work habits to the FTL. However, all changes that may affect the work control documents must have concurrence from the appropriate project technical representatives and a data analysis report should be prepared when required.

3. EXPOSURE MONITORING AND SAMPLING

A potential for exposure to industrial safety hazards and chemical, radiological, and physical agent hazards exists during project tasks and may affect all personnel who work in those tasks listed in Table 2-3. Refinement of work control zones (see Section 7), use of engineering and administrative controls, worker training, and wearing PPE provides the mitigation strategy for these hazards. Monitoring and sampling will be used during project tasks to (1) assess the effectiveness of these controls, (2) determine the type of PPE needed for individual tasks, and (3) determine the need for upgrading and downgrading PPE as described in Section 5. Monitoring will be conducted in and around the active work location(s) on a periodic basis and as determined based on site-specific conditions.

Table 2-3 lists the tasks and hazards to be monitored. Table 3-1 lists the action levels and associated responses for specific hazards.

3.1 Exposure Limits

Exposure limits identified in Table 2-2 work with the initial action limits listed in Table 3-1 for specific project tasks. Project tasks will be continually assessed in accordance with PRD-25, "Activity Level Hazard Identification, Analysis, and Control," and evaluated by Radiological Control [RadCon] and Industrial Hygiene personnel to ensure engineering control effectiveness. Action limits should be adjusted (as required) based on changing site conditions, exposure mitigation practices, and PPE levels.

The RCT survey requirements were incorporated as best management practices into the NPTF operating TPRs during the review and approval process. Inclusion of the RCT survey requirements focused on breaching system internals to ensure that radiological conditions have not changed beyond those anticipated. Should radiological contamination be detected that meets or exceeds the levels defined in Table 2-2 of *Manual 15A–Radiation Protection–INEEL Radiological Control Manual*, use of an RWP will be required. The RWP will specify the appropriate level of PPE to be worn for work in radiological control areas. Whenever a worker leaves a controlled area, a complete personnel and equipment contamination survey will be performed. In the event that workers find radiological contamination in excess of 100 counts during a personnel survey, they must contact a TAN RCT. Contact information shall be posted near the radiological survey instrumentation per PRD-183, "Radiation Protection—INEEL Radiological Control Manual," or reviewed during the pre-job briefing. The RCTs will conduct radiological monitoring, as appropriate, to monitor occupational exposure levels and ensure that the project mitigates any potential for spreading contamination.

3.2 Environmental and Personnel Monitoring

Industrial Hygiene and RadCon personnel will conduct periodic monitoring with direct-reading instrumentation, collect swipes, and conduct full- and partial-period air sampling (as deemed appropriate) in accordance with the applicable MCPs, OSHA substance-specific standards, and as stated in the RWP. Instrumentation will be selected based on the site-specific conditions and contaminants associated with project tasks. The RCT and IH will be responsible for determining the best monitoring technique for radiological and non-radiological contaminants, respectively. Safety hazards and other physical hazards will be monitored and mitigated, as outlined in Section 2.

Table 3-1. Action levels for the task site.

Contaminant/Agent Monitored	Action Level	Response Taken if Action Levels Exceeded
Organic vapors (VOCs)	<5 ppm in workers' breathing zone	Continue working, periodic monitoring (minimum every 5 minutes).
	5–10 ppm sustained for 1 minute in workers' breathing zone	Continue working, continue monitoring or don minimum of Level C respiratory protection,[a] and continue working.
	10–50 ppm in workers' breathing zone	If episodic—leave area until vapor dissipates, monitor continuously or don minimum Level C respiratory protection, and continue working. If sustained—don minimum Level C respiratory protection.[a]
	>50 ppm in worker's breathing zone	**Evacuate area**: **If episodic, don Level C respiratory protection[a] and continue periodic monitoring.** **If sustained, consult HSO and FTL to determine course of action.**
Altered oxygen levels	≥23.5% or <19.5%	Stop work until concentrations are between 23.5 and 19.5%.
Hazardous noise levels	<85 dBA for 8-hr TWA, <84 dBA for 10-hr TWA	No action
	85–114 dBA	Hearing protection is required to attenuate to below 85 dBA for an 8-hr TWA or 84 dBA for a 10-hr TWA (based device NRR).
	(a) >115 dBA (b) >140 dBA	(a) Isolate source, evaluate NRR for single device, double protection as needed (b) Control entry, isolate source, only approved double protection worn
Radiation field	<5 mrem/hr	No action; no posting is required.
	5–100 mrem/hr at 30 cm (§835.603.b)	Post as "Radiation Area"—Required items: RW I or II training, RWP, personal dosimetry.
	>100 mrem—500 Rad at 100 cm (§835.603.b)	Post as "High Radiation Area"—Required items: RW II, RWP, alarming personal dosimetry, dose rate meter, and temporary shielding (as required).
	Exceed remote area monitor's alarming set point, if required (fast ringing bell, flashing red light)	Evacuate area immediately, muster at CRZ, and await instruction from RCT.
	Alarm from personal electronic dosimeter (audible chirp)	Move back to nearest exit control point, allow electronic dosimeter to reset (area of reduced general area fields), and notify RCT and await instruction.
Radionuclide contamination	1—100 times RCM Table 2-2 values (§835.603.d)	Post as "Contamination Area." Required items: RW II training, personal dosimetry, RWP, don PPE, bioassay submittal (as required).

Table 3-1. (continued).

Contaminant/Agent Monitored	Action Level	Response Taken if Action Levels Exceeded
	>100 times RCM Table 2-2 values (§835.603.d)	Post as "High Contamination Area"—Required items: RW II training, personal dosimetry, RWP (with pre-job briefing), don PPE, bioassay submittal (as required).
Airborne radioactivity	Concentrations (μCi/cc) >30% of appropriate DAC value (§835.603.d)	Post as "Airborne Radioactivity Area"—Required items: RW II training, personal dosimetry, RWP (with pre-job briefing), don PPE, bioassay submittal (as required).

a. Level C respiratory protection will consist of a half- or full-face air-purifying respirator equipped with a HEPA, chemical, or combination cartridge as prescribed by the project IH. See Section 9, "Personal Protective Equipment," for additional Level C requirements.

CRZ = contamination reduction zone
DAC = derived air concentration
dBA = decibel A-weighted
FTL = field team leader
HEPA = high-efficiency particulate air
HSO = health and safety officer
IH = industrial hygienist
NRR = noise reduction rating
PPE = personal protective equipment
RCM = Radiological Control Manual
RCT = radiological control technician
TWA = time-weighted average
VOC = volatile organic compound

3.2.1 Industrial Hygiene Area and Personal Monitoring and Instrument Calibration

The project IH will conduct full- and partial-period sampling of airborne contaminants and monitoring of physical agents at a frequency deemed appropriate based on direct-reading instrument readings and changing site conditions. All air sampling will be conducted using applicable National Institute of Occupational Safety and Health (NIOSH), OSHA, or other validated method. Both personal and area sampling and monitoring may be conducted.

Various direct-reading instruments may be used to determine the presence of non-radiological and other physical agents. The frequency and type of sampling and monitoring will be determined by changing site conditions, direct-reading instrument results, observation, professional judgment, and in accordance with the MCP-153, "Industrial Hygiene Exposure Assessment."

All monitoring instruments will be maintained and calibrated in accordance with the manufacturer's recommendations, existing Industrial Hygiene protocol, and in conformance with the companywide safety and health manuals: *Manual 14A–Safety and Health–Occupational Safety and Fire Protection* and *Manual 14B–Safety and Health–Occupational Medical and Industrial Hygiene*. Direct-reading instruments will be calibrated, at a minimum, before daily use and more frequently as determined by the project IH. Calibration information, sampling and monitoring data, results from direct-reading instruments, and field observations will be recorded, as stated in Section 12.

3.2.2 Area Radiological Monitoring and Instrument Calibration

Area radiological monitoring will be conducted during project tasks to ensure that personnel are given adequate protection from potential radiological exposure. Instruments and sampling methods deemed appropriate by the RCT and as required by project- or task-specific RWPs may be used. When conducted, monitoring will be performed in accordance with *Manual 15B–Radiation Protection Procedures* and *Manual 15C–Radiological Control Procedures.* Radiological Control personnel will use the data obtained from monitoring to evaluate the effectiveness of engineering controls, decontamination methods, and procedures and to alert personnel to potential radiation sources.

Radiological Control personnel will use radiation and contamination detectors and counters to provide radiological information to personnel. Daily operational and source checks will be performed on all portable survey instruments to ensure that they are within the specified baseline calibration limits. Accountable radioactive sources will be maintained in accordance with MCP-137, "Radioactive Source Accountability and Control." All radiological survey and monitoring equipment will be maintained and calibrated in accordance with the manufacturer's recommendations, existing RadCon protocol, and in conformance with MCP-93, "Health Physics Instrumentation."

3.2.3 Personnel Radiological Exposure Monitoring

Personal radiological monitoring will be conducted to quantify radiation exposure and potential for uptakes as stated in the project- or task-specific RWP. This may include the use of external dosimetry, surface monitoring, and internal dosimetry methods to ensure that engineering controls, administrative controls, and work practices are effectively mitigating radiological hazards.

3.2.3.1 External Dosimetry. Dosimetry requirements will be based on the radiation exposure potential during project tasks. When dosimetry is required, all personnel who enter the project area will be required to wear personal dosimetry devices, as specified by RadCon personnel and the RWP and in accordance with Manual 15A.

When RWPs are required for project tasks, the Radiological Control and Information Management System (RCIMS) will be used to track external radiation exposures to personnel. Individuals are responsible for ensuring that all required personal information is provided to RadCon personnel for entry into RCIMS and logging into RCIMS when electronic dosimeters are used.

3.2.3.2 Internal Monitoring. The purpose of internal dose monitoring is to demonstrate the effectiveness of contamination control practices and to document the nature and extent of any internal uptakes that may occur. Internal dose evaluation programs will be adequate to demonstrate compliance with 10 CFR 835, "Occupational Radiation Protection." The requirement for whole body counts and bioassays will be based on specific project tasks or activities and will be determined by the radiological engineer. Bioassay requirements will be specified on the RWP and project personnel will be responsible for submitting required bioassay samples upon request.

The TAN Radiological Engineering Department reviewed analytical data of the radionuclides anticipated to be encountered during NPTF operations. The review was completed in accordance with MCP-191, "Radiological Internal Dosimetry," to determine, or establish, personnel bioassay monitoring requirements. The review focused on tritium (H-3) as the contaminant of concern. Tritium (H-3) was detected in the groundwater wells—designated as TAN-38, -39, and -40—from which water will be pumped for treatment at the NPTF.

Activity concentrations of H-3 from the TAN-38, -39, and -40 wells were detected at 5.0E+03 pCi/L, 6.0E+03 pCi/L, and 6.0E+03 pCi/L, respectively. The three wells were analyzed for the presence of Cs-137 and Sr-90. The TAN-38 and TAN-39 wells indicated no presence of either radioisotope. The TAN-40 well was reported at <0.23 pCi/L (non-detectable) for Sr-90 and <2.7 pCi/L (non-detectable) per the laboratory counting equipment's minimum detectable activity. The results of the radiological engineering review concluded that personnel bioassay sampling would not be required from exposure to the TAN groundwater and the entrained H-3. The results of the calculations were documented using Form 441.29, "Job Specific Bioassay Evaluation," and were filed with the TAN internal dosimetry coordinator and in the project files.

4. ACCIDENT AND EXPOSURE PREVENTION

Project activities will present numerous safety, physical, chemical, and radiological hazards to personnel conducting these tasks. It is critical that all personnel understand and follow the site-specific requirements of this HASP. Engineering controls, hazard isolation, specialized work practices, and the use of PPE will all be implemented to eliminate or mitigate all potential hazards and exposures where feasible. However, all personnel are responsible for the identification and control of hazards in their work area in accordance with Integrated Safety Management System (ISMS) principals and practices. **At no time will hazards be left unmitigated without implementing some manner of controls (e.g., engineering controls, administrative controls, or the use of PPE)**. Project personnel should use stop work authority in accordance with PRD-1004 or MCP-553, "Stop Work Authority," where it is perceived that imminent danger to personnel, equipment, or the environment exists.

This HASP is to be used in conjunction with PRD-25, "Activity Level Hazard Identification, Analysis, and Control," and work authorization and control documents such as STD-101; MCP-9106, "Management of INEEL Projects"; MCP-2863, "Construction Work Coordination and Hazards Control"; work orders; JSAs; MCP-3562, "Hazard Identification, Analysis, and Control of Operational Activities"; and operational technical procedures. Where appropriate, MCP-3562 and GDE-6212, mitigation guidance, JSAs, and RWPs are incorporated into applicable sections of this HASP.

4.1 Voluntary Protection Program and Integrated Safety Management System

The INEEL safety processes embrace the Voluntary Protection Program (VPP) and ISMS criteria, principles, and concepts to identify and mitigate hazards, thereby preventing accidents. All management and workers are responsible for implementing safety policies and programs and for maintaining a safe and healthful work environment. Project personnel are expected to take a proactive role in preventing accidents, ensuring safe working conditions for themselves and fellow personnel, and complying with all work control documents, procedures, and permits.

The **ISMS** is focused on the **system** side of conducting operations and **VPP** concentrates on the **people** aspect of conducting work. Both programs define work scope, identify and analyze hazards, and mitigate the hazards; additional information on these programs is available on the INEEL Intranet. Bechtel BWXT Idaho, LLC (current primary management and operating contractor) and its subcontractors participate in VPP and ISMS for the safety of their employees. This document includes all elements of both systems. The five key elements of VPP and ISMS and their corresponding HASP sections are as follows:

Voluntary Protection Program	Integrated Safety Management System	Health and Safety Plan Section
—	Define work scope	Section 1
Work site analysis	Analyze hazards	Sections 2, 3, 5, and 8
Hazard prevention and control	Develop and implement controls	Sections 2, 3, 4, 5, 7, 10, and 11
Safety and health training	Perform within work controls	Section 6
Employee involvement	Perform within work controls	Sections 2, 3, and 4
Management leadership	Provide feedback and improvement	Section 6 and 9

4.2 General Safe-Work Practices

Sections 1 and 2 defined the project scope of work and associated project-specific hazards and mitigation. The following practices are mandatory for all project personnel to further reduce the likelihood of accidents and injuries. All visitors permitted to enter work areas must follow these requirements. Failure to follow these practices may result in permanent removal from the project and other disciplinary actions. The project FTL and HSO will be responsible for ensuring that the following safe-work practices are adhered to at the project site:

- Limit work area access to authorized personnel only in accordance with PRD-1007, "Work Coordination and Hazard Control," and Section 7.

- All personnel have the authority to initiate STOP WORK actions in accordance with PRD-1004 and MCP-553.

- Personnel will not eat, drink, chew gum or tobacco, smoke, apply sunscreen, or perform any other practice that increases the probability of hand-to-mouth transfer and ingestion of materials in work areas, except within designated areas.

- Be aware of and comply with all safety signs, tags, barriers, and color codes as identified in PRD-2022, "Safety Signs, Color Codes, and Barriers" and PRD-5117, "Accident Prevention Signs, Tags, Barriers, and Color Codes."

- Be alert for dangerous situations, strong or irritating odors, airborne dusts or vapors, and spills that may be present. Report all potentially dangerous situations to the FTL or HSO.

- Avoid direct contact with hazardous materials or waste. Personnel will not walk through spills or other areas of contamination and will avoid kneeling, leaning, or sitting on equipment or surfaces that may be contaminated.

- Be familiar with the physical characteristics of the project site, including, but not limited to, the following:

  - Prevailing wind direction

  - Location of fellow personnel, equipment, and vehicles

  - Communications at the project site and with TAN-607

  - Area and the type of hazardous materials stored there

  - Major roads and means of access to and from the project site

  - Location of emergency equipment

  - Warning devices and alarms for area or facility

  - Capabilities and location of nearest emergency assistance.

- Report all broken skin or open wounds to the operations manager, FTL, or HSO. An OMP physician must examine all wounds to determine the nature and extent of the injury. If required to enter into a radiological contamination area, a RadCon supervisor will determine whether the wound can be bandaged adequately in accordance with Article 542 of *Manual 15A–Radiation Protection–INEEL Radiological Control Manual*.

- Prevent releases of hazardous materials. If a spill occurs, personnel must try to isolate the source (if possible and if this does not create a greater exposure potential) and then report it to the FTL or HSO. The Warning Communications Center (WCC) will be notified and additional actions will be taken, as described in Section 10. Appropriate spill response kits or other containment and absorbent materials will be maintained at the project site.

- Illumination levels during project tasks will be in accordance with 29 CFR 1910.120 (Table H-120.1, "Minimum Illumination Intensities in Foot-Candles").

- Ground-fault protection will be provided and checked daily whenever temporary electrical equipment is used. In addition, only rated extension cords shall be used.

- Keep all ignition sources at least 15 m (50 ft) from explosive or flammable environments and use non-sparking, explosion-proof equipment, if advised to do so by safety professionals.

- Follow all safety and radiological precautions and limitations of technical procedures and requirements identified in the work packages.

4.3 Subcontractor Responsibilities

Subcontractors are responsible for meeting all applicable INEEL MCP, PRD, VPP, and ISMS flow-down requirements such as those listed on the completed INEEL Form 540.10, "Safety Checklist of Subcontractor Requirements for On-Site Nonconstruction Work"; *Subcontractor Requirements Manual* (TOC-59); and contract general and special conditions. In addition, subcontractors are expected to take a proactive role in hazard identification and mitigation while conducting project tasks and must report unmitigated hazards to the appropriate project point of contact after taking mitigative actions within the documented work controls.

4.4 Radiological and Chemical Exposure Prevention

Using engineering controls, administrative controls, or PPE to prevent exposures where possible or minimize them where engineering controls are not feasible will mitigate exposure to potential chemical, radiological, and physical hazards. All project personnel are responsible for understanding the hazard identification and mitigation measures necessary to prevent exposures.

4.4.1 Radiological Exposure Prevention—As Low as Reasonably Achievable Principles

Radiation exposure of project personnel will be controlled such that radiation exposures are well below regulatory limits and that there is no radiation exposure without commensurate benefit. **Unplanned and preventable exposures are considered unacceptable.** All project tasks will be evaluated with the goal of eliminating or minimizing exposures. All project personnel have the responsibility for following as-low-as-reasonably-achievable (ALARA) principles and practices, and personnel working at the site must strive to keep both external and internal radiation doses ALARA by adopting the following practices.

4.4.1.1 External Radiation Dose Reduction. Sources for external radiation exposure at the project site can be found in Table 2-3. Radiological work permits will be written as required for project tasks that will define hold points, required dosimetry, RCT coverage, radiological controlled areas, and radiological limiting conditions in accordance with MCP-7, "Radiological Work Permit." Radiological Control personnel will participate in the pre-job briefing required by MCP-3003, "Performing Pre-Job Briefings and Post-Job Reviews," to ensure that all personnel understand the dose rate limits and limiting conditions on the RWP. All personnel will be required to read and acknowledge the RWP requirements before being allowed to sign the RWP (or scan the RWP bar code) and obtain electronic dosimetry.

Basic protective measures used to reduce external doses include (1) minimizing time in radiation areas, (2) maximizing the distance from known sources of radiation, and (3) using shielding whenever possible. The following are methods to minimize external dose:

Methods for Minimizing Time

The following are methods for minimizing time:

- Plan and discuss the tasks before entering a radiation area (including having all equipment and tools prepared).
- Perform as much work as possible outside radiation areas and take advantage of lower dose rate areas (as shown on the radiological survey maps).
- Take the most direct route to the tasks and work efficiently.
- If problems occur in the radiation areas, hold technical discussions outside radiation areas, then return to the work area to complete the task.
- If stay times are required, know your stay time and use the appropriate signal and communication method to let others in the area know when the stay time is up.
- Respond to electronic dosimetry alarms by notifying others in the area and the RCT, and exit the radiation area through the designated entry and exit point.
- Know your current dose and your dose limit. DO NOT EXCEED YOUR DOSE LIMIT.

Methods for Maximizing Distance from Sources of Radiation

The following are methods for maximizing the distance from sources of radiation:

- Use remote-operated equipment or controls where required
- Stay as far away from the source of radiation as possible (extremely important for point sources where, in general, if the distance between the source is doubled, the dose rate falls to one-fourth of the original dose rate)
- Become familiar with the radiological survey map for the area in which work will be performed as well as high and low dose-rate locations, and take advantage of low dose rate areas.

Proper Use of Shielding

The following are requirements for proper use of shielding:

- Know what shielding is required and how it is to be used for each radiation source
- Take advantage of the equipment and enclosures for shielding yourself from radiation sources
- Wear safety glasses to protect eyes from beta radiation.

4.4.1.2 Internal Radiation Dose Reduction. An internal radiation dose potential exists from activities listed in Table 2-3. An internal dose is a result of radioactive material being taken into the body. Radioactive material can enter the body through inhalation, ingestion, absorption through wounds, or injection from a puncture wound. Reducing the potential for radioactive material to enter the body is critical to avoid an internal dose. The following are methods to minimize the internal radiation dose hazard:

- Know the potential and known contamination sources and locations, and minimize or avoid activities in those areas
- Wear protective clothing and respiratory protection as identified in the RWP, perform all respirator leak checks, and inspect all PPE before entering contaminated areas or areas with airborne radioactivity
- Use a high-efficiency particulate air (HEPA) filter exhaust system
- When inside contaminated areas, do not touch your face (adjust glasses or PPE) or other exposed skin
- When exiting contaminated areas, follow all posted instructions and remove PPE in the order prescribed (if questions arise, consult RadCon personnel)
- Conduct whole body personnel survey when exiting the contaminated area, then proceed directly to the personnel contamination monitor
- Report all wounds or cuts (including scratches and scrapes) before entering radiologically contaminated areas
- Wash hands and face before eating, drinking, smoking, or engaging in other activities that may provide a pathway for contaminants.

Monitoring for radiation and contamination during project tasks will be conducted in accordance with the RWP; PRD-183; *Manual 15A–Radiation Protection–INEEL Radiological Control Manual; Manual 15B–Radiation Protection Procedures;* and *Manual 15C–Radiological Control Procedures*, and as deemed appropriate by RadCon personnel.

4.4.2 Chemical and Physical Hazard Exposure Avoidance

Note: Identification and control of exposures to carcinogens will be conducted in accordance with MCP-2703, "Carcinogens."

Threshold-limit values (TLVs) or other occupational exposure limits have been established for numerous chemicals and physical agents (e.g., noise, heat, or cold stress) that may be encountered. These exposure limits provide guidelines in evaluating airborne, skin, and physical agent exposures. The TLVs represent levels and conditions under which it is believed that nearly all workers may be exposed day after day without adverse health effects. The TLV time-weighted average is a time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek, to which it is believed that nearly all workers may be repeatedly exposed, day after day, without adverse health effects. Action limits (instantaneous concentrations for short time periods) have been established (Section 3) to further reduce the likelihood of exceeding TLVs.

Controls will be employed to eliminate or mitigate chemical and physical hazards wherever feasible. The hierarchy of controls in order are (1) engineering controls, (2) administrative controls, and (3) PPE. In addition to these controls, use of technical procedures and work orders, hold points, training, and monitoring of hazards will be used (as appropriate) to reduce exposure potential. Some methods of exposure avoidance include:

- Wearing all required PPE, inspecting all pieces before donning, and taping all seams
- Changing PPE if it becomes damaged or shows signs of degrading
- Minimizing time in direct contact with the hazardous material
- Doff PPE following standard practices (i.e., rolling outer surfaces in and down) and follow doffing sequence
- Wash hands and face before eating, drinking, smoking, or engaging in other activities that may provide a pathway for contaminants.

4.5 Buddy System

The two-person or buddy system will be used during project tasks. For intensive tasks—such as project activities requiring the use of Level C or higher PPE, respiratory protection, or where heat/cold stress and other hazards may impede a person's ability to self-rescue—the buddy system shall be implemented by both individuals remaining in visual contact with one another in order to assess and monitor his or her buddy's mental and physical well-being during the course of the activity. In addition, during intensive tasks, the buddy must be able to:

- Provide assistance if required
- Verify the integrity of the buddy's PPE
- Observe his or her buddy for signs and symptoms of heat stress, cold stress, or contaminant exposure
- Notify other personnel in the area if emergency assistance is needed.

During other non-intensive tasks (monitoring operation of the NPTF, checking the valve on a well, etc.), the buddy system may instead be implemented via radio or telephone communication. If clarification is required, the buddy system will be administered by the FTL in conjunction with the HSO.